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Rare-Earth Doped Phosphate-Glass Lasers & Associated Methods

Inexpensively mass produce highly reproducible, accurate, and stable integrated optical systems that include high-powered fiber lasers with routing and other components

Description

This invention is a method and device for integrating lasers and optics on glass substrates. Inexpensively produce laser components consisting of monolithic arrays of individual waveguides forming laser resonator cavities with differing resonance characteristics (e.g., resonating at differing wavelengths). The component can be part of a laser system outputting laser light at many selected wavelengths. The resonance characteristics of a waveguide cavity are varied by adjusting the width of the channel formed in the substrate which changes the effective refractive index of the waveguide. The effective refractive index can also be changed by modifying the diffusion conditions under which the waveguides are formed.

A diffraction Bragg reflector (DBR) grating may be formed into or close to the waveguide to tune the wavelength of light supported in the waveguide cavity. Changing the effective refractive index changes the effective wavelength of light in the waveguide cavity which determines the wavelengths of the longitudinal modes supported by the cavity.

The laser component overcomes high energy requirements and reduces noise by providing an undoped region through which light signals can be transmitted and in which passive devices can be located. The undoped region provides a pathway by which pump light from an external source can be directed to laser amplifiers or resonators in the substrate without intervening absorption of the light by a laser or sensitizer species.

Applications

- **Telecommunications**
  Optimizes current and enables future wavelength-division multiplexing applications.

Advantages

- **High output and slope efficiencies**
  Outputs up to and exceeding 170 milliwatts, and provides slope efficiencies of up to and exceeding 26%.
- **Inexpensive, mass production**
- **Reduces energy requirements and signal noise**
- **Reliable**
  Provides reproducible and stable output wavelengths.

Abstract

Apparatus and method for integrating lasers and optics on glass substrates. An optical (e.g., laser) component formed from a glass substrate doped with a optically active lanthanides species with a plurality of waveguides defined by channels within the substrate. The laser component optionally includes a monolithic array of individual waveguides in which the waveguides form laser resonator cavities with differing resonance characteristics. Another aspect is directed toward pumping the laser wherein a superstrate waveguide cavity, or cladding, Ls positioned adjacent the substrate waveguide for supplying the latter with pump light. A closed crucible processing of optical waveguides on a glass substrate is also described. Waveguides are created by exposing a surface of the substrate to an ion-exchange solvent (e.g., a molten salt). A tightly sealed multi-part crucible is provided in order that gas does not leak in or out of the crucible during cooling or heating of the system.

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References

- U.S. Patent #6,970,494 issued 11-29-2005, expires 01/25/2020
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Status of Availability

This invention is available for exclusive or non-exclusive commercialization licensing. Collaborative research opportunities are available.

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